



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/665,309	09/22/2003	Chen-Hua Yu	252011-1670	5444
47390	7590	10/14/2005	EXAMINER	
THOMAS, KAYDEN, HOSTEMEYER & RISLEY LLP 100 GALLERIA PARKWAY SUITE 1750 ATLANTA, GA 30339			LE, THAO X	
			ART UNIT	PAPER NUMBER
			2814	

DATE MAILED: 10/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/665,309

Applicant(s)

YU ET AL.

Examiner

Thao X. Le

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 August 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 19-25 and 27-42 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 19-25, 27-42 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 19 August 05 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to

Art Unit: 2814

consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 19, 20, 22-25, 28-30, 33, and 42 are rejected under 35 U.S.C. 103(a) as being unpatentable over US PUB 20040077181 to Choo et al in view of US 6660627 to Hu et al.

Regarding claims 19 and 42; Choo discloses a metal structure in fig. 5, comprising: a semiconductor substrate 40 [0062], with a conductor 42 [0063] thereon; an insulating layer 46 [0066] overlying semiconductor substrate 40 having a hole therein exposing the conductor 42, fig. 4, a conductive plug 58 [0074] substantially filling the hole and the underlying electrically connecting conductor 42; a etch stop layer 48 overlying the insulating layer 46 and the conductive plug 58; a low dielectric constant layer 50 [0069] overlying the etch stop layer 48; a trench in the low dielectric constant layer 50 and the etch stop layer 48, fig. 5, a diffusion layer 56 [0073] lining the trench; and a copper or copper alloy conductor 58 substantially filling the trench, electrically connecting the conductive plug 58.

But, Choo does not discloses the etch stop layer 48 comprises a carbon-doped silicon oxide or carbon and nitrogen-doped-containing film.

However, Choo discloses the etch stop layer in the conventional dual damascene fabrication practices use SiN, SiCO (carbon-doped silicon oxide), SiCN or SiC [0003]. Further more, Hu discloses the etch stop layer 40 comprises SiO₂, SiN, SiON, SiC, SiCO, or SiOCN, column 3 line 7. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to

Art Unit: 2814

replace the etch stop teaching of Choo with Hu's etch stop layer, because such etch stop material is conventional in the art and the etch stop material is being selected according to its etch selectivity [0004]. And because such material replacement would have been considered a mere substitution of art-recognized equivalent values, MPEP 2144.06.

Regarding claims 20, Choo discloses the structure wherein the conductive plug 58 comprises tungsten [0074].

Regarding claim 22, Choo discloses the structure wherein the semiconductor substrate 40 comprises silicon germanium [0062].

Regarding claims 23-25, Choo discloses the structure wherein the conductor 42 is composed of metal [0063], wherein the insulating layer 46 comprises USG [0066], wherein the thickness of the etch stop layer 48 is about 200 to 700 Å⁰ [0067],

Regarding claim 27, Choo and Hu do not disclose the structure wherein the carbon content exceeds 20%.

However, the carbon content in layer 40 of Hu would be around 17%.

Accordingly, it would have been obvious to one of ordinary skill in art to combine the teaching of Choo and Hu in the range as claimed, because it has been held that where the general conditions of the claims are disclosed in the prior art, it is not inventive to discover the optimum or workable range by routine experimentation. See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

Regarding claims 28-30, Choo discloses the structure wherein the dielectric constant (k) of the low dielectric 50 is less than 3.0 and comprises inorganic and/or organic film [0069]. Although the prior art does not specially disclose the claimed 'the dielectric constant (k) of the low dielectric 50 is less than 3.0, this feature is seen to be inherently teaching of that limitation, because material such as Black Diamond™ would have k value of about 2-3.

The process limitations "CVD or spin on" in claim 29 do not carry weight in a claim drawn to structure. In re Thorpe, 277 USPQ 964 (Fed. Cir. 1985).

Regarding claim 33, Choo discloses the structure further comprises a Ta and/or TaN lining layer 56 [0073].

5. Claims 21, 31-32, 34-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over US PUB 2004/0077181 to Choo et al in view of US 6566701 to Agarwal.

Regarding claim 21, Choo discloses the structure wherein the conductor 42 comprises Cu or W [0063].

But Choo does not disclose the structure wherein the conductor 42 comprises metal silicide.

However, Agarwal reference discloses the conductive plug 34, fig. 9, can be Cu, W, or metal silicide, column 4 lines 58-67. At the time of the invention was made; it would have been obvious to one of ordinary skill in the art to use the conductive plug teaching of Agarwal with Choo's device, because either Cu, W or metal silicide can be used as a conductor material.

Regarding claims 31-32, Choo does not disclose the hole having the width less than 950°A , and the trench having the width less than 1300°A .

But Choo discloses the structure wherein the width of the hole and the trench having general with, fig. 5. Accordingly, it would have been obvious to one of ordinary skill in art to use the width teaching of Engel in Choo's device in the range as claimed, because it has been held that where the general conditions of the claims are disclosed in the prior art, it is not inventive to discover the optimum or workable range by routine experimentation. See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

Regarding claim 34, Choo a metal structure, comprising: a semiconductor substrate 40 with conductor 42 comprising copper thereon, an insulating layer 46 overlying the semiconductor substrate 40 having a hole therein exposing the conductor, fig. 4, a conductive plug 58 substantially filling the hole and electrically connecting the underlying conductor 42; a etch stop layer 48 overlying the insulating layer 46 and the conductive plug 58; a low dielectric constant layer 50 [0069] overlying the etch stop layer 48; a trench in the low dielectric constant layer 50 and the etch stop layer 48, fig. 5, a diffusion layer 56 [0073] lining the trench; and a copper or copper alloy conductor 58 substantially filling the trench, electrically connecting the conductive plug 58.

But, Choo does not disclose the conductor 42 comprising nickel silicide the etch stop layer 48 comprises a carbon-doped silicon oxide or carbon and nitrogen-doped-containing film.

However, Choo discloses the etch stop layer in the conventional dual damascene fabrication practices use SiN, SiCO (carbon-doped silicon oxide), SiCN or SiC [0003]. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the teaching of Choo as claimed, because SiCO etch stop material is conventional in the art and the etch stop material is being selected according to its etch selectivity [0004],

With respect to conductor comprising nickel silicide, Agarwal discloses the conductive plug 34, fig. 9, can be Cu, W, or nickel silicide, column 4 lines 58-67. At the time of the invention was made; it would have been obvious to one of ordinary skill in the art to use the conductive plug teaching of Agarwal with Choo's device, because either Cu, W or nickel silicide can be used as a conductor material.

Regarding claims 35, Choo discloses the structure wherein the conductive plug 58 comprises tungsten [0074].

Regarding claims 36, Choo discloses the wherein the thickness of the etch stop layer 48 is about 200 to 700 Å [0067].

Regarding claim 37, Choo discloses the structure wherein the carbon content of the layer 48 exceeds 20% (the molecular ratio of SiCO is about 50/21.4/28.6)

Regarding claim 38, Choo discloses the structure wherein the dielectric constant (k) of the low dielectric 50 is less than 3.0. Although the prior art does not specially disclose the claimed 'the dielectric constant (k) of the low dielectric 50 is less than 3.0,

this feature is seen to be inherently teaching of that limitation, because material such as Black Diamond™ would have k value of about 2-3.

Regarding claims 39-40, Choo does not disclose the hole having the width less than 950⁰A, and the trench having the width less than 1300⁰A.

But Choo discloses the structure wherein the width of the hole and the trench having general with, fig. 5. Accordingly, it would have been obvious to one of ordinary skill in art to use the width teaching of Engel in Choo's device in the range as claimed, because it has been held that where the general conditions of the claims are discloses in the prior art, it is not inventive to discover the optimum or workable range by routine experimentation. See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

Regarding claim 41, Choo discloses the structure further comprises a Ta and/or TaN lining layer 56 [0073].

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thao X. Le whose telephone number is (571) 272-1708. The examiner can normally be reached on M-F from 8:00 AM - 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M. Fahmy can be reached on (571) 272 -1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 2814

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, consisting of several horizontal strokes and a vertical line, appearing to read 'Thao X. Le'.

Thao X. Le
27 Aug. 2005